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# FUTURE WAR PAPER

## *MILITARY ANDROIDS: A VISION FOR HUMAN REPLACEMENT IN 2035*

**SUBMITTED IN PARTIAL FULFILLMENT**
**OF THE REQUIREMENTS FOR THE DEGREE OF**
**MASTER OF OPERATIONAL STUDIES**

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**The evolution of unmanned military systems over the last few decades, beginning with Unmanned Aerial Vehicles (UAV) and more recently Unmanned Ground Vehicles (UGV), is the nascent steps in the replacement of human beings from direct involvement in the conduct of warfare. This evolution is driven by a desire to reduce the risk for loss of life. As this evolution continues, and improvements are made in field of robotics, there will come a point around the year 2035 where some soldiers or Marines will be replaced by androids. For the purposes of this paper, an android is defined as an artificial system that is indistinguishable from human beings in both its external appearance and behavior, and is capable of interaction with actual human beings.**

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### *Introduction*

The evolution of unmanned military systems over the last few decades, beginning with Unmanned Aerial Vehicles (UAV) and more recently Unmanned Ground Vehicles (UGV), is the nascent steps in the replacement of human beings from direct involvement in the conduct of warfare.  This evolution is driven by a desire to reduce the risk for loss of life.  As this evolution continues, and improvements are made in field of robotics, there will come a point around the year 2035 where some soldiers or Marines will be replaced by androids.  For the purposes of this paper, an android is defined as an artificial system that is indistinguishable from human beings in both its external appearance and behavior, and is capable of interaction with actual human beings.

### *Why Androids in the Military?*

The current trend of removing human beings from combat is in its infancy, but has the potential to accelerate exponentially over the next twenty-five years due to reasons such as advancements in technology and aversion to bloodshed.  This accelerated in the United States with the passage of the National Defense Authorization Act of 2001, which set acquisition goals for the Department of Defense to produce UAVs and UGVs.[1]  The United States Air Force clearly described their long-term plans to unman large portions of its force when it released the *Unmanned Aerial System (UAS) Flight Plan 2009-2047* in August of 2009.[2]  The plan is designed to increase warfighting capabilities, "while promoting service interdependency and the wisest use of tax dollars."  The plan details the dramatic reduction of manned aircraft in exchange for more flexible, lethal, plentiful and affordable UAVs that are "compelling where the human is a limitation to mission success."[3]  This is not just a future concept; it is happening now.  As of August 2009, the Air Force will annually train more pilots to fly UAVs than to fly manned

aircraft.[4]  The unmanning of aircraft is being driven primarily by two factors: cost, and the requirement to execute missions that are too risky, too long, too dull or too strenuous for human beings.  The Air Force may remove the man from the airplane, but it is not substituting with an android pilot because simply it doesn't matter to anyone what the airplane looks like.

A similar trend is underway with UGVs.  For example, Qinetiq Corporations Modular Advanced Armed Robotic System (MAARS) is a UGV that can be armed with a medium machine gun, four 40mm grenade launchers, and a host of sensors and designators neatly packed onto a tracked chassis that sits at waist height.[5]  MAARS bears no resemblance to a human being at all, but it could serve as a suitable substitute for a machine gunner, grenadier, courier, reconnaissance man, or other ground combatant depending upon what is placed on the chassis.  Like many of the UAVs fielded, it is currently a "man in the loop" system, meaning that there is an operator running it via remote control.  Similar to unmanning the airplane, it doesn't really matter what the killing or logistics UGV looks like provided it can perform its assigned mission.

Thus, if it doesn't matter how the future airplane bombs the enemy, or how the future un-manned vehicle locates, closes with, and destroys the enemy, why build a military android at all?  Androids would be useful at places on the battlefield where human interaction and response are critical.  Functions such as gathering human intelligence, conducting civil affairs or key leadership engagements cannot be effectively conducted with a system like MAARS.  Androids will, in fact, enhance the capabilities to conduct these types of operations.  In the contemporary operating environment there is a struggle to simply field sufficient translators or teach basic cultural awareness to military personnel; an android could simply plug in a language module and get the download for local culture.  Moreover, an android could digitally coordinate his actions with adjacent androids and other automated systems to enhance the effectiveness of its operation,

and the operations of the force as a whole.  The android will not be a panacea, but will be part of a suite of systems that include UAVs and UGVs that unman the future battlefield.  To genuinely appreciate the future potentials and limitations of androids, it is important to first understand the state of androids today.

### *The Current State of Android Art*

Android research and development is much further along than most people probably realize, but it is not surprising given their cultural attitudes towards robotics that Japan and South Korea have developed the most advanced models thus far.  An internet search for androids such as the Asimo, Actroid, Repliee, or the Geminoid will immediately yield a myriad of web page and video results that demonstrate just how advanced these machines are.  These systems are developed for many and varied reasons, including research and development, entertainment, and geriatric care.

Asimo, developed by Honda and billed as "the world's most advanced humanoid robot," does not look like a human being, but is capable of remarkably advanced feats in robotics.  A glance at the videos on Honda's Asimo website show that it may live up to its billing.  Asimo is capable of walking, collision avoidance, interactive speech, and more complex tasks such as care of elderly patients, service as a waiter, and even conducting the Detroit Symphony Orchestra.  Asimo is limited by a one-hour battery life, a running speed of 3.7 miles per hour, and a requirement for a workstation and portable controller to operate, [6]  While Asimo does not fit this paper's definition of an android in that there is little resemblance to a human, it is important because of the enabling technologies associated with it.  Asimo is capable of semi-autonomous operations and continued development will expand those capabilities.

Actroid, developed by the Kokoro Company of Japan, is an android line that debuted in November 2003 at the International Robot Exhibition. In 2005, the company continued development of the Actroid along three lines of operation: platform types for research, platform types for practical application, and platform types for entertainment. Videos available on the company's website show various models of the Actroid, and their more advanced Repliee model, performing tasks such as singing, holding conversations with human beings, emceeing conventions, and serving as a tour guide and hostess.[7] Actroid is important because it is capable of limited human interaction; however, it is clear when observing current models of Actroid that it is not quite human.

Geminoid, developed by Dr. Hiroshi Ishiguro of the Intelligent Robotics and Communications Laboratory near Kyoto, Japan, is a remote controlled doppelganger of its creator. Geminoid looks and acts so much like its creator that in 2005 Dr. Ishiguro used it to teach a portion of his course at Osaka University, and then surprised his students by walking out from behind a curtain as the Geminoid continued class.[8] The Geminoid is important because it has demonstrated the capability of fooling an audience, albeit from a distance and for a short period of time, but it is currently incapable of independent operation.

Contemporary androids are on the near side of the Uncanny Valley (see figure 1). The Uncanny Valley is a term that describes the uneasy feeling that many people have as robots, mannequins and other doppelgangers begin to look more and more lifelike, but aren't quite indistinguishable from human beings. Because they are on the near side of the Uncanny Valley, they are not suited for activities that require them to pass as human.
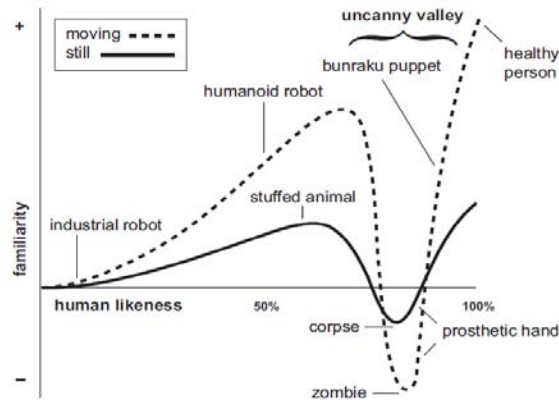
Figure 1.  In 1970, robot designed Masahiro Mori graphed what the relation between human likeness and perceived familiarity: familiarity increases with human likeness until a point is reached at which subtle deviations from human appearance and behavior create an unnerving effect. This he called the *uncanny valley*. According to Mori (1970), movement amplifies the effect.[9]

Contemporary androids are too limited in their capabilities to serve in a military capacity. They lack staying power, do not have genuine independence for more than a short period of time, and their artificial intelligence is not on par with that of a human being… for now.  This will change by 2035.

### *The State of Android Art in 2035*

Some futurists, such as Dr. Raymond Kurzweil, and corporations such as Intel, are proponents of theories such as Moore's Law or the Law of Accelerating Returns that attempt to account for the pace of technological improvements.  Moore's Law, developed by the head of the Intel Corporation, states that the number of transistors that can be placed on a microchip will double roughly every two years.  The increase in computational power is matched by a reduction in production cost.[10]  Dr. Kurzweil took Moore's Law one step further with his Law of Accelerating Returns and posited that the there is "an exponential growth in the rate of exponential growth."[11]

If we assume that either theory is correct regarding technological growth, it is inevitable that a machine will pass the "Turing Test."  This test is named for Alan Turing, who argued in his 1950 paper, "Computing Machines and Intelligence," that a machine would not be able to

fool a human being into believing that the machine was a human being also.[12] Kurzweil takes the increase a step further and believes that by 2023 a computer with the capacity of the human brain will cost approximately $1,000, and that by 2035 the human brain equivalent cost will be reduced to 1 cent.[13] If Kurzweil is correct, an android, and probably the toaster and the coffee pot, have the potential to be smarter than the human being. At that point, whether or not the android has genuine intelligence, learning capabilities, a soul or feelings will be immaterial. The repository of information and rules governing its employment within the machine will be so vast that a human being will be unable to distinguish between a human response and an android's response.

Advances in maneuverability will accompany increased intelligence. Today, systems such as Boston Dynamic's "Petman" are already capable of near anthropomorphic movements such as "heel-toe walking," and recovering its balance from pushes or shoves.[14] As previously stated, the power systems for Asimo already exist today that can run it for an hour, and it is reasonable to believe that by 2035 this timeline will be increased significantly.

It is also reasonable to believe that androids will be near indistinguishable from human beings. Closer android resemblance to human beings will not be driven by military requirements, but rather from sources such as the entertainment and geriatric care industries. In 2035, there will be a competitive imperative on the part of robotics manufacturers to produce android models for these industries that are on the far side of the Uncanny Valley.

Once the Uncanny Valley is crossed, it is unlikely that a military organization somewhere on the Earth will not place an android in uniform. The initial introduction might be for something as mundane as employment in human resources, but these machines will find their way onto the future battlefield. If it seems difficult to conceive, consider that the Wright

Brothers first flew in 1903 and sold their first aircraft to the U.S. Army Signal Corps in 1909.[15] Androids will come just as fast.

### *Reduction of Risked Blood and Treasure*

Simply put, android troops in 2035 could be cheaper to field and maintain than the human counterparts they will replace. Human beings are very expensive to train and equip properly, and are very expensive to pay for when they are killed. An admittedly incomplete examination of the cost to send one hypothetical service member to Iraq during the first decade of the 21st century, and lose him to hostile action near the end of his deployment comes with a price tag of nearly one million US dollars (see table 1). It is not likely that these personnel costs will come down in the next 25 years.

| | |
|---|---|
| Cost to recruit 1 member of the armed forces[16] | $14,000 |
| Cost to train 1 recruit at MCRD San Diego[17] | $13,300 |
| Cost to deploy 1 soldier for a year to Iraq[18] | $390,000 |
| Cost of 1 MEDEVAC flight hour[19] | $11,000 |
| Serviceman Group Life Insurance Death Benefit[20] | $400,000 |
| Death Gratuity[21] | $100,000 |

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| **Total** | $928,300 |

Table 1 – Sample costs associated with the recruiting, training, deployment and loss of a US service member.

Contemporary androids are expensive and limited in capability. The Actroid, for example, cost $225,000 when first offered for public sale in December 2009, but was unable to walk.[22] This high-cost-low-capability combination will not continue. In a manner similar to the dramatic inverse cost decrease and capability increase of the personal computer over the last 25 years, in the next 25 years the cost of androids will be reduced significantly despite an enormous increase in capability.

As androids become cheaper and more capable, sending them to war becomes less of an investment of blood and treasure for a country – *why send a man when I can send an android (and a few contractors)?* It will make warfare more antiseptic and further alienate the military

from the general population of the country.  People on the home front will see fewer images of

their fellow countrymen wounded on the battlefield.  News stories about lengthy rehabilitation at

Walter Reed Hospital or permanent disfigurement of servicemen won't populate the airwaves of

Fox News.  More than ever, war may become something that is happening "over there."

### *Implications of Dehumanizing War*

While replacing a human being with an android or other machine reduces a nation's

risked blood and treasure during a conflict, there are significant potential positive and negative

implications.  These implications will play out within military organizations, society at large,

governments, enemies, and allies.

### *Invalidation of Contemporary Military Organizational Paradigms*

Ground-based military forces have historically organized themselves into echelons such

as teams, squads, platoons, companies, battalions, and so on.  Generally speaking, each

succeeding echelon in the chain of command up is made up of three or four subordinate elements

plus a leadership element to conduct command and control and potentially some unique enabling

capabilities.  This type of organizational paradigm was developed because it fits within a human

being's effective span of control.  It would be incredibly inefficient to apply this model to

androids because their span of control will be greater or even just plain different.

Two potential models for the basis of new military organizational paradigms are offered

in P. W. Singer's book, *Wired for War.*  The "mothership" concept is when many automated

systems (including androids, robots, and UAVs) are dispatched and controlled by one centralized

hub.[23]  The obvious distinction between this concept and contemporary command and control is

the span of control.  Under the "mothership" concept there could be hundreds of systems

responding to one node, thus a military employing this concept would have a few flat

organizational diagram.  The "swarm" concept is when many automated systems work in concert with each other without a clearly defined centralized control.[24]  Swarming systems may share a collective consciousness through wireless or other communications means and execute their responsibilities by following sets of rules.  Today it is unclear if either of these are the correct model, or if there is another to be developed, but what is clear is that the number of human beings needed to plan and coordinate the actions of androids and automated systems will likely be far fewer because these systems will have a larger span of control.

Just as laborers often oppose increased automation in the manufacturing sector, there will be a degree of revulsion amongst military professionals and organizations whose positions and interests are threatened by the introduction of androids.  This has already happened.  Early Predator UAV pilots in the US Air Force were not given career credit commensurate with their unmanned flight hours when compared to their manned counterparts.[25]  The UAV simply did not fit into the military's culture; time and two wars have changed this somewhat.  It is likely that civil affairs officers, human intelligence specialists, and others that are likely candidates for replacement by android will object just as strenuously.

Combat Service Support (CSS) organizations will change in order to support android deployment.  Significantly less food, water, medical supplies, and personal comfort items will be required to support the android enabled force.  A machine will be a better marksman, and will thus require less ammunition than human beings have historically expended.  Significantly more repair parts, lubricants and batteries, however, will be required to support the android enabled force.  Fewer medical personnel will be required to support the android enabled force, but additional and unique maintenance capabilities may require forward deployment.  This may require an enormous contractor presence, development of "repairbots" or uniformed humans to

keep androids running.  Although it is difficult to determine whether or not this will represent a net savings in logistics expenditures, suffice it to say that CSS organizations in 2035 will look dramatically different than they do now.

### *Decline of the Contemporary Military Professional and Effects on Society at Large*

The human military professional in the android equipped force of 2035 will have little in common with his contemporary counterpart.  The military professional could be removed from the immediate danger and confusion encountered at the tactical level of war.  Personnel at the lowest echelons of military service would be involved in maintenance and logistical support of machines. Operational level planners and command and control personnel will probably still be in place, but their responsibilities and training will have to be very different.  These personnel will not be afforded the opportunity to "cut their teeth" at the tactical level and mature over time. Instead, they will have to spend more time training in simulations to understand the new character of war and devote the preponderance of their time to understand the nature of war. These planners and command and control personnel will have to be very highly educated because their span of control will be radically larger than it is today.  Remaining military personnel, whether operating at the tactical or operational level will measure their training pipeline in years rather than weeks or months, and there will be very few of them.

Although it would be natural to assume there would be a significant increase in unemployment if military jobs were given to androids or other robots, the overall impact of this increase will not be as severe as one might think.  A 2008 Center for Naval Analysis study on the millennial generation shows that there is a gradual decline in propensity of generations to seek military service over time (see figure 2).[26]  If decline in propensity continues through 2035, there

will not be many Americans seeking military service and the loss of those jobs will have no

impact on employment. It will simply be a change in the economy.

Less Americans serving in the military may cause unusual second order consequences.

Many people join the military for training, and millions of Americans have used the G.I. Bill to

fund their way through college or other higher education. The absence of these opportunities

may decrease the overall quality of the nation's workforce, or cause a requirement for additional
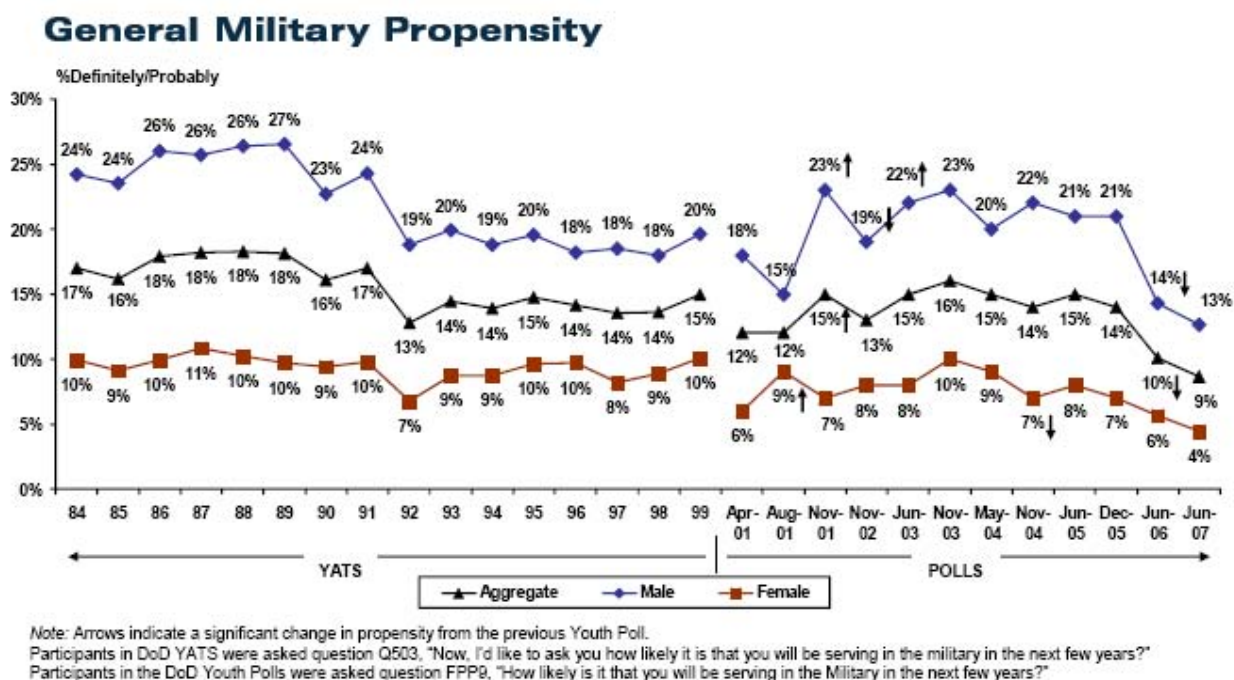
entitlements to support worker quality.

## General Military Propensity



Note: Arrows indicate a significant change in propensity from the previous Youth Poll.
Participants in DoD YATS were asked question Q503, "Now, I'd like to ask you how likely it is that you will be serving in the military in the next few years?"
Participants in the DoD Youth Polls were asked question FPP9, "How likely is it that you will be serving in the Military in the next few years?"

Figure 2. The 2008 CNA study *A Review of Millenial Generation Characteristics and Military Workforce implications* shows that aggregate propensity to join the military has decreased by nearly half.

If there are fewer military veterans, this will likely accelerate the current trend showing a

reduction of lawmakers who have had military experience. This trend began in the Congress in

1977 when over 77% of lawmakers had some form of military experience, and continues to date

where less than one-third of lawmakers have some form of military experience.[27] This is simply

the Congress being representative of the people; there are fewer veterans today, therefore there

will be fewer veteran lawmakers. This will not necessarily make the Congress any more or less

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likely to authorize and fund a war. It will, however, be a reflection of the increased alienation of mainstream American society from the military, simply because there will be less military people to know.

Overseas conflict involving the 2035 android equipped force will be less personal to Americans. They will be less likely to know someone who has first hand experience in a war, and will be more likely to form their opinions of the conflict based upon what they see in the news. Discounting the idealistic, war will matter less to people. Or, to put it another way, with apologies to the original Marine author who was serving in Iraq, "The androids are at war. America is at the mall."

### *Potential Effects on Asymmetrically Equipped Adversaries*

An android equipped force will have a distinct advantage over its adversaries. While androids might serve in uniformed roles when conducting civil affairs work, they could just as easily be outfitted in local garb, with language capability and cultural routines allowing them to blend into the population. An android like this could gather intelligence on High Value Individuals (HVI), record evidence, make positive identification, and transmit coordinates for weapons employment without ever being noticed. This capability will increase the effects of precision weapons and allow for a more persistent collections capability. It will force adversaries in hiding to come up with unique ways of vetting the people closest to them, such as dogs, blood oaths or perhaps a medical examination to prove their humanity.

Depending on the culture and tenacity of the adversary, reactions will vary. The presence of machines that can't be "killed" may be completely demoralizing, or equally as emboldening. Whatever the effect, adversaries will need to determine new tactics to confront a changed character of war.

A stated goal of Al Qaeda has been to harm the United States economically. This goal

has manifested itself most visibly in spectacular terrorist attacks, and more subtly through the

substantial "subsequent costs of the U.S. military response" against the organization.[28] Cheaper

androids will present a less lucrative economic target than a corresponding soldier or Marine that

costs the US nearly a million dollars to replace. This may negate part of Al Qaeda's strategy and

cause it to seek other indirect approaches to attacking the US economy such as additional attacks

on the homeland or softer targets overseas.

Reliance on androids and other robots may leave US forces vulnerable to hackers. As

recently as December of 2009, the news headlines carried concerns of Iranian-backed hackers

gaining access to UAVs over Iraq with $26 commercial off the shelf software.[29] It is logical that

future adversaries would seek out affordable asymmetric means to attack androids to gain

intelligence or take outright control of those systems. Occurrences such as this are likely to be

on the margins, just as they are now, because countermeasures will be developed as

vulnerabilities in the system are understood. These cyber attacks on the margins simply won't

cause us to live out a scenario similar 1983's movie *War Games* in which a hacker nearly causes

a nuclear World War III.[30]

### *Potential Effects on Asymmetrically Equipped Allies and Non-Combatants*

Android equipped forces will enjoy greater interoperability with coalition partners and

non-combatants at the lowest levels. In the contemporary military, there is a decided lack of

personnel with the required language capabilities to be immediately effective in a conflict. There

are at least five languages spoken in Iraq and six in Afghanistan.[31] Today, US military personnel

who effectively speak any of these eleven languages are few and far between, and were even less

in number during the initial phases of the conflicts (not to mention the various languages of

coalition members).  By 2035 an android will be capable of simply downloading the language, or multiple languages, giving it the ability to interact effectively and immediately with coalition partners and non-combatants.  This will increase both the speed and effectiveness of operations that are usually hampered by simple factors such as translation time.

Androids will reduce information fratricide.  Current US doctrine places the onus on headquarters units to "prevent information fratricide by subordinate units through integrating mechanisms, which most often comes through daily or weekly synchronization meetings."[32] While this is the most effective means currently available in the contemporary operating environment, it cannot provide detailed guidance to every servicemember to cover every situation he might encounter when interacting with indigenous peoples or coalition members. Moreover, human beings often misinterpret instructions, especially when it comes to guidance related to information operations messages.  This leads to conflicting information across the battlefield.  Androids will not have this difficulty.  Each machine will receive the same guidance, and will spread the same information operations message.  In situations where the guidance received doesn't cover the situation, the android will be capable of seeking guidance instantly and disseminating the additional instructions to its peers across the battlefield in order to avoid information fratricide.

Non-combatants will likely have one of two reactions when they realize there are androids on the battlefield (and they will once an android is damaged).  By 2035, androids may be so commonplace and such a part of every day life that it won't be a big deal.  It may also radicalize previously neutral peoples and drive them into the arms of an adversary's information operations campaign.  The latter has already shown it self.   In 2007, one of the most popular songs in Pakistan related to America's lack of honor when it came to the employment of UAVs

to conduct strikes.[33]  This will require careful consideration on the part of military planners when it comes to choosing when and where androids are employed on the battlefield.

In future coalition warfare, there are going to be "haves" and "have-nots."  Amongst allies, there is potential for dissent as android and robot equipped forces from one nation may not be seen as an equitable commitment to the nation providing its sons.  This could have significant repercussions in subsequent coalitions where the "have-nots" may become unwilling to risk any of their personnel, thus leaving the android equipped "haves" alone to carry on the conflict.

### *Conclusion*

Androids will likely be part of day to day life by 2035 - civilian industries will see to that. Once that happens, it may not take long for them to be employed in military service.  The unmanning of the front lines will change the character of war as much or more than the introduction of the airplane, submarine, tank or rifle.  The introduction of androids and other automated systems will make the character of warfare nearly unrecognizable to military personnel who served during the Cold War or the Global War on Terrorism.  The introduction of UAVs and UGVs to the battlefield are simply the pre-cursor moves before man makes a robot in his own image.  Androids will change how people fight, just as civilian applications of the technology will change how they live.  If men like futurist Raymond Kurzweil and author Peter Singer are right, the change may come exponentially faster than humanity is ready for.

While the character of war will change, so long as humans are making policy the nature of war will not change – it will remain "continuation of politics by other means."  Clausewitz's observations on the nature of war will remain valid, and it will be an imperative for the nation to have trained leaders that genuinely understand them because they will have nothing to refer to with respect to the character of war.  This will require new paradigms in order to reconcile the

new character of war with the enduring nature of war, and more importantly, it will require

professionals to devote themselves to understanding both.

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